

Indeed, it will be speedily ascertained by those who start the course that the experiments indicated require considerably more time than is ordinarily devoted to this branch of botany; however, in this case there is no great objection to superfluity, as it is a simple matter to leave out those experiments considered to be less important. In the circumstances the author was well advised to touch only lightly upon the sensitivity of plants, which is discussed in the last chapter.

The general method of exposition is original, and a certain number of experiments, such as that devised by Dr. F. Blackman for illustrating the dependance of germination upon oxygen supply are additions to the courses generally followed in botanical laboratories. There is overmuch insistence on the correlation of guessing, reasoning, and trying, and perhaps a superabundance of chemical and physical tests. But these are minor matters of opinion, whereas there can be no question that the book is original, vigorous, and stimulating.

The Statesman's Year-Book. Statistical and Historical Annual of the States of the World for the Year 1911. Edited by Dr. J. Scott Keltie. Pp. lxxii + 1412. (London: Macmillan and Co., Ltd., 1911.) Price 10s. 6d. net.

THIS is the forty-eighth annual issue of a work of reference which has become indispensable to administrators, statesmen, and students of economics and geography. The volume has been thoroughly revised and brought up to date—a preliminary section of additions and corrections including the results of the 1911 census of the United Kingdom. A series of new maps is provided, and these include maps of the new projected railway routes to India; railways, navigable waters, and steamship routes; the new Liberian Boundary, 1909; the northern territory of Australia; and of the Panama Canal from the latest reports of the Isthmian Canal Commission.

Several sections of the book have been greatly improved—those dealing with Turkey, Spain, and China may be mentioned. Altogether this issue of the "Year-Book" will preserve the high reputation the work has secured, and the editor may well be congratulated upon his efforts to maintain the accuracy and usefulness of the volume.

Catalogue of the Serial Publications in the Library of the Manchester Literary and Philosophical Society. Compiled, under the direction of the honorary librarian, C. L. Barnes, by A. P. Hunt. Pp. vi + 177. (Manchester: Published by the Society, 1911.) Price 2s. 6d.

THE object of this catalogue is to make known the wealth of periodical scientific literature in the library of the Manchester Literary and Philosophical Society. The total number of current publications at present received by the society is 810, and they come from all parts of the world and cover every branch of science. The catalogue is excellently arranged, and is provided with an exhaustive index. It should be of great service to members of the society and to others engaged in scientific research.

The Lore of the Honey-Bee. By Tickner Edwardes. Pp. xx + 196. (London: Methuen and Co., Ltd., 1911.) Price 1s. net.

THE first edition of Mr. Edwardes's book on the bee was reviewed in the issue of NATURE for November 5, 1908 (vol. lxxix., p. 6). This fourth edition is a cheap re-issue of what has already proved a popular work; and, at its present price, such an interesting history of the folk-lore of the bee and account of its activities should become known to a wider circle of readers.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Deformation of Rocks under Tidal Load.

I HAVE read with interest Prof. Milne's letter under the above title in NATURE of July 13, and congratulate him on the promising character of the results. As he himself remarks, the subject theoretically is not a new one. Its geophysical interest lies largely in the possibility of deriving information from the observed phenomena as to the elastic character of the earth's crust. Several difficulties, however, stand in the way of this information. The earliest mathematical treatment of the problem, so far as I am aware, is that by Sir G. H. Darwin, to which Prof. Milne refers. The problem which he actually solved relates to the effect of load on the surface of an elastic solid material which is *homogeneous, isotropic, and incompressible*. In ignorance of this solution, I obtained another¹ in 1896—a simple deduction from the important solution by Prof. Boussinesq for material bounded by an infinite plane—which is somewhat more general, in so far as it does not assume incompressibility in the material, but otherwise is subject to the same limitations. In practice, the most important of these limitations are probably the assumptions of homogeneity and isotropy. Very possibly, an expert mathematician familiar with recent developments of the mathematical theory of elasticity might have no serious difficulty in removing these restrictions in part or in whole. For instance, if a solution were obtained for the case where there is a relatively thin superficial layer differing in elastic quality from the remainder, it would immediately throw light on what is to be expected from differences in the surface strata.

The solution derived from Boussinesq's for the homogeneous solid is simple, the formula for the vertical component w of the elastic displacement at a point in the plane of the loaded surface being²

$$w = \{(1-\eta)/2\pi n\} \iint (\rho/r) d\sigma,$$

where ρ is the normal pressure over the element $d\sigma$ on surface, situated at a distance r from the point where w is being measured, n denotes the rigidity, and η Poisson's ratio for the material, dw/dx gives the slope measured in the direction of the axis of x , supposed horizontal. We see at once that however complex the distribution of load may be, the slope varies directly as $1-\eta$, and inversely as n . For a given value of n it is 50 per cent. greater when Poisson's ratio is $\frac{1}{4}$ —as it approximately is in steel—than when the material is incompressible.

There is, however, another aspect of the case that has to be taken into account. The influence of the tide does not consist solely of the pressure effect. At high-tide we have a large additional quantity of gravitating material, the attraction of which modifies the direction of gravity at the land station. If we compare the readings of a delicate spirit level at mid-tide and at high-water, there is an apparent change of level $\psi_1 + \psi_2$, made up of ψ_1 due to the actual slope of the surface carrying the level, and ψ_2 due to the alteration in the direction of local gravity. Under the conditions postulated in my solution of the problem

$$\psi_1/\psi_2 = 2(1-\eta)gpa/3n,$$

where g is gravity, a the earth's radius, and ρ its mean density. The ratio varies enormously for values of η and n that exist in known materials. Thus we have, measuring n in grammes weight per sq. cm.,

$$\begin{aligned} \eta = 0.25, \quad n = 80 \times 10^7, \quad \psi_1/\psi_2 &= 2 \text{ approximately,} \\ &= 0.5, \quad n = 11 \times 10^7, \quad = 11 \quad \text{,,} \end{aligned}$$

The first thing to be considered is what does the instrument used actually record? Is it ψ_1 or $\psi_1 + \psi_2$? In the latter event, unless ψ_2 is relatively negligible, we must

¹ See *Phil. Mag.*, March, 1897, p. 173.

² Proc. Physical Society, vol. xv, p. 35, and *Phil. Mag.*, l.c., p. 177.

calculate it before we can arrive at the true bending effect. If the material is homogeneous and elastic, the vertical plane of steepest slope at any place contains the direction of the resultant gravitational force. But while the gravitational effect must be as instantaneous as gravity itself, the bending effect will show a lag unless the material is perfectly elastic, so far, at least, as tidal load is concerned. It is manifestly a case in which measurement of the apparent slope in two perpendicular planes is likely to add materially to knowledge. An estimate which I made in 1896 for the effect of tides in the Thames at Kew Observatory, assigning the low value of 11×10^7 grammes weight per sq. cm. to the rigidity, and assuming the material incompressible, made the difference of the slope between extreme high- and low-water only of the order $0''.05$, and so too small to be measured satisfactorily by the Milne seismograph at the observatory. CHARLES CHREE.

July 15.

Hamilton and Tait.

It may at first sight seem a little ungracious to take exception to a statement in the extremely gratifying review of the "Life and Scientific Work of P. G. Tait," which "A. G." contributed to NATURE of July 13. But the point is one which brings out in a remarkable degree the great modesty of Tait in regard to his own achievements. Your reviewer says that Tait "was introduced by Andrews to Rowan Hamilton, at that time in the full tide of his quaternion work, and busy with the preparation of the 'Elements' for publication."

Now it is, I think, clearly established in the "Life," by means of quotations from Hamilton himself, that when the correspondence with Tait began Hamilton had stopped working at quaternions, that the correspondence drew Hamilton back to the study of his calculus, and that, as I put it in the "Life," p. 132, it was Tait "who fired Hamilton with the ambition to write his second great 'Treatise on Quaternions.'" This is proved by Hamilton's own words, quoted on p. 131 of the "Life." Since possibly many readers may not be interested in the quaternion side of Tait's activities, I take the liberty of reproducing this quotation here. Writing on January 21, 1859, Hamilton remarked:—

"As to myself I cheerfully confess that I consider myself to have, in several respects, derived advantage, as well as pleasure, from the correspondence. It was useful to me, for example, to have had my attention recalled to the whole subject of the quaternions, which I had been almost trying to forget; partly under the impression that nobody cared, or would soon care, about them. The result seems likely to be that I shall go on to write some such 'Manual,' not necessarily a very short one—as that alluded to in a recent paragraph."

It seems clear that without the Tait correspondence, Hamilton would never have undertaken the second treatise. This was one of the discoveries which I was privileged to make when the correspondence was committed to my care. To me it was a very surprising discovery. I had often conversed with Tait about his relations with Hamilton—and he was critical as well as appreciative in these reminiscences—but I never heard him say anything as to the part he played in the first beginnings of the "Elements." In his own writings, such as the prefaces to the successive editions of his treatise, or the biographical notices he wrote of the great Dublin mathematician, Tait had ample opportunities of telling the story of his intimate connection with Hamilton's second treatise. But not the least hint was ever given. It may be that Tait felt his hands tied because of the absence of any reference in the "Elements" to the correspondence. But we must remember that Hamilton did not live to complete his work or to write more than the merest fragment of a preface. Now that we know the truth from Hamilton's own letters, the whole episode is a fine example of Tait's modesty, and even self-effacement, in regard to his influence in shaping scientific development. The story throws such a beautiful light upon the character of Tait that I am sure your reviewer will thank me pointing out the one slight inaccuracy in an otherwise perfect review. C. G. KNOTT.

Edinburgh University, July 17.

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The Fruiting of the Tamarisk.

THIS exceptional season is having strange effects on many of our native plants and animals, and naturalists would do well to note these before it is too late.

For many years I have tried without success to find *Tamarix anglica* in fruit in Britain. The absence of fruit, and the rarity of the tamarisk except where obviously planted, seemed to support the idea that it was of fairly modern introduction.

A few years ago, however, fragments of rope, found in Roman Pevensey and sent to Kew, were pronounced to be formed in part from the inner bark of tamarisk. This seemed to favour the inclusion of the tamarisk in the British flora, though rope found in a Roman seaport may quite well have been manufactured abroad.

This season the negative evidence yielded by the absence of seed has also broken down; and if a plant seeds once in its lifetime, it may hold its own and establish its right to a place in our flora—as the Cornish elm has done.

I planted last spring some young tamarisks on a steep bank of loose sand in my garden at Milford. During the long drought they received no water; they are now seeding freely, and the winged seeds are being dispersed by the wind. If the plant reproduces itself from these seeds, sown under natural conditions, the cycle will be complete; but the garden is a quarter of a mile from the sea, and the test may be too severe a one.

Tamarisk is essentially a desert and sea-coast plant, and it would be worth while to examine any tamarisks growing on sand-dunes, to see whether they also are seeding, and to see whether seedlings come up. Possibly the tamarisk may be a survivor from times when desert or "loess" conditions extended over western Europe. We have found the fossil remains of many of the desert animals, but plants decay in porous deposits of dust, and desert plants are seldom washed into ordinary alluvial deposits. CLEMENT REID.

Milford-on-Sea, Hampshire.

Sunshine and Fleas.

ARISTOTLE (H.A. viii. 605 δ) makes the following curious and perplexing statement:—*πάντα δὲ τὰ ἔντομα ἀποθνήσκει ἐλατούμενα· τάχιστα δ', ἂν τις τὴν κεφαλὴν ἀλείψας ἐν τῷ ἡλίῳ θῇ*. That is to say: "All insects die if they be smeared with oil; and they die all the more rapidly if you smear their head with the oil and lay them out in the sun." So Pliny, Albertus Magnus, and recent commentators read and interpret the passage. But in the former half of the sentence, for *ἐλατούμενα*, several MSS. read *ῥηλιτούμενα*: i.e. not "if they be smeared with oil," but simply "if they be exposed to the sun"; while in the latter half there is an obvious ambiguity, which inclines me to think that *τὰ ἔντομα* is used *sensu restricto*, and that *τὴν κεφαλὴν* refers, not to the insect's head, but to the experimenter's.

I take it, in short, that the heat of the sun was the main agent recommended for the destruction of the insects, and it is interesting to find this agency again coming into practical use for a very similar purpose. One of the latest of the Indian Medical Department's "Scientific Memoirs," by Capt. J. Cunningham, is entitled "On the Destruction of Fleas by Exposure to the Sun." The writer recommends the wholesale disinfection of clothing and baggage, for the special purpose of destroying plague-carrying fleas, by the simple process of laying out the garments or bedding on a sandy floor, exposed to the full rays of the sun. The author has made many careful and elaborate experiments, and has succeeded in showing that in less than an hour's time, under an Indian sun, the fleas are all dead.

D'ARCY W. THOMPSON.

The Oban Pennatulida Again.

MARINE biologists may be interested to hear that the bed, near Oban, of the largest British pennatulid *Funiculina quadrangularis*, and the smaller *Virgularia mirabilis* described by Mr. W. P. Marshall and the late Prof. Milnes Marshall in 1881 or 1882 (I have no books of reference with me) is still apparently in very flourishing condition. In a couple of hauls of the small Agassiz trawl, from this yacht yesterday, between the islands of Kerrera and Lisimore, at depths of eighteen to twenty fathoms, I got about